Electro-Voice®

TL550D

Low-Frequency Speaker System

- **Designed for cinema stage use (behind the screen)**
- **Extended, 40-Hz response (f_3)**
- **Two EVX-150A woofers provide very high peak and long-term output that complements the dynamic potential of digital sound on film**
- **Use as primary low-frequency source in two-way systems or as the sub-woofer in multiway systems**
- **2,000 watts continuous program**
- **Side-mounted connection panel facilitates hookup when depth behind the screen is restricted**
- **28-Hz f_3 in step-down, ideal for very-low-frequency synthesized effects, down-tuned bass guitars or pipe organ**
- **Optional HS6 or HS7 hanging kits—through-the-box steel tubes provide safe suspension**

Description and Applications

The Electro-Voice TL550D is a member of the TL series of low-frequency enclosures. The TL550D is a dual direct-radiating vented design that provides high efficiency, low distortion and excellent low-frequency performance in a compact enclosure. The TL550D employs two long-throw EVX-150A 15-inch loudspeakers, in an 8.4-ft^3, black-finished enclosure without grille. It is specifically designed to meet the low-frequency demands of digital cinema sound, in stage (behind-the-screen) applications. The TL550D's high pumping capability, high acoustic output ability and extended bass response (40-Hz 3-dB-down point) make it particularly appropriate for the dynamic potential of the digital cinema application. The side-mounted input panel facilitates behind-the-screen installation, where limited space between the screen and the theatre wall often makes it difficult to connect to the back of an enclosure.

The TL550D's performance characteristics also make it highly appropriate as the primary low-frequency source in extended-response/high-output two-way speaker systems in a variety of other venues, including auditoriums, theaters, performing arts centers, night clubs, concert halls and churches, or as the subwoofer in large, multiway systems. In subwoofer use, the TL550D's 40-Hz 3-dB-down point is appropriate for most contemporary music playback and sound reinforcement. In the "step-down mode," the TL550D's f_3 is lowered to 28 Hz, which makes it appropriate for very-low-frequency synthesized effects, down-tuned bass guitars, and approaches the depths of the symphony orchestra and pipe organ. (See Step-Down section.)

The TL550D can be used with an externally mounted XEQ-504 crossover/equalizer. Thus, combined with appropriate Electro-Voice TransPlanar™ constant-directivity high-frequency horns and DH1A, DH2A or N/DYM®1 compression drivers, the TL550D forms passive two-way systems with unprecedented wide-range frequency response and high linearity. To extract even greater performance from the TL550D, a biamp configuration using the Electro-Voice XEQ-2 or XEQ-3 crossover/equalizer is recommended, allowing full rated power to be applied to the low-frequency system.

Two optional horn-mounting kits are available for the Electro-Voice HP940 and HP9040 horns. (See High-Frequency Horn Mounting section.)

Frequency Response

The TL550D's axial frequency response was measured in Electro-Voice's large anechoic chamber at a distance of 10 feet with a swept sine-wave input of 4 volts. Figure 1 has been averaged and corrected for 1 watt/1 meter.

Directivity

The directional characteristics of the TL550D were measured in Electro-Voice's large anechoic chamber; the test signal was one-third-octave filtered pink noise at the frequencies indicated. A full spherical measurement system was used, which is compatible with the AcoustaCADD™ computer-aided design program. All directional information was measured at 20 feet.

Figure 2 illustrates the horizontal and vertical polar responses. Figure 3 shows the horizontal and vertical beamwidths. Beamwidth is the angle at which the horizontal and vertical polar responses have decreased in level by 6 dB when compared to the axial frequency response.

Figure 4 illustrates the total directivity of the TL550D. The directivity factor R_q (Q) is the relative value, at a point, of the TL550D when compared to an ideal spherical response. The directivity index, D_i, is calculated by $D_i = 10 \log R_q$.

Power Handling Capacity

To our knowledge Electro-Voice was the first U.S. manufacturer to develop and publish a power test closely related to real-life conditions. A random noise input signal is used because it contains many frequencies simultaneously, just like real voice or instrument program. The signal contains more energy at extremely high and low frequencies than typical actual program, adding an extra margin of reliability. The test combines not only the overall long-term average or continuous level—which our ear interprets as loudness—but also short-duration peaks which are many times higher than the average, just like actual program. The long-term average level stresses the speaker thermally (heat). The instantaneous peaks test mechanical reliability (cone excursion). Note that the sine-wave test signals sometimes used have a much less demanding peak value relative to their average level. In actual use, long-term average levels exist from several seconds on up. We test for several hours, adding another extra level of reliability.

Specifically, the TL550D is designed to withstand the power test described in EIA Standard RS-426A. The EIA test spectrum is applied for eight hours. The spectrum is obtained by filtering white noise (a particular type of random noise with equal energy per bandwidth). The filter applies a 6-dB-per-octave slope below 40 Hz and above 318 Hz. When measured with a one-third-octave constant-percentage analyzer, this filter produces a spectrum whose 3-dB-down points are at 100 Hz and 1,200 Hz with a 3-dB-per-octave slope above 1,200 Hz. This shaped signal is fed to the power amplifier with the continuous power set to provide 1,200 watts into the 4.8-ohm EIA equivalent impedance (75.9 volts rms).

Amplifier clipping sets instantaneous peaks at 6 dB above the continuous power, or 4,800 watts peak (151.8 volts peak). This procedure provides a rigorous test of both thermal and mechanical failure modes.

The TL550D has also been power tested with a two-hour sine wave, at minimum impedance, so that competitive comparisons can be made using consistent methods. Continuous program power is defined as 3 dB above (double) the continuous sine-wave power rating.

Step-Down

Step-down is a method of extending the low-frequency response by increasing the power input to the system instead of the enclosure volume. In step-down mode, the enclosure is tuned at a lower-than-normal frequency. This increases the output at the new tuning frequency and reduces the output at the original tuning frequency. This smoothly falling amplitude response can be equalized to obtain a new 3-dB-down point in the region of 0.7 that of the original. To obtain a similar response without step-down would require an enclosure with at least twice the volume.

Step-down can be instigated by using the supplied port cover. The enclosure tuning will be lowered from 42 to 30 Hz.

If an appropriate low-frequency boost-and-cut equalization is applied, the normal f_3 of 40 Hz is reduced to 28 Hz. It is suggested that the Electro-Voice XEQ-2 or XEQ-3 active crossover be used to provide the required equalization. The suggested equalization is an underdamped second-order high-pass filter tuned to 29 Hz with a Q of 2. This provides a boost of 6 dB at the tuning frequency and a 12-dB-per-octave roll-off below. This filter is directly available on the XEQ-2 or can be generated in the XEQ-3 by using the optional EB29/35 EQ module.

Subpassband Speaker Protection

Below the enclosure tuning frequency, cone excursion increases rapidly. Since acoustic output is also falling rapidly, there is no utility in driving the system with signals much below tuning frequency. While such signals may be in the program material, they are often extraneous, such as a dropped microphone. The step-down equalization described in the Step-Down section provides the required protection. If step-down mode is not used, the Electro-Voice EX-24, XEQ-2 and XEQ-3 electronic crossover/equalizers can also provide subpassband protection. The 3-dB-down points are 30 Hz (EX-24 and XEQ-2) and 16 Hz or 32 Hz (XEQ-3).

Other high-pass filters are available and one-third-octave equalizers can also be effective at providing the required protection.

Use In Multiples

Cone loudspeakers may be stacked for greater acoustic output and a narrower beamwidth. (It is assumed that all cones are operating in unison or "in phase.") This principle is already employed in the dual-woofer TL550D, and is responsible for the higher sensitivity and narrower vertical beamwidth (with the system long axis vertical) relative to similar single-woofer systems. In addition, two TL550D's can be used side-by-side and their combined performance will be different from that of a single TL550D in the ways outlined below.

At relatively low frequencies, below about 150 Hz for typical TL series dimensions, stacking produces additional acoustic output without altering dispersion. When a common signal is applied, a 6-dB increase in maximum acoustic output occurs. The cones "mutually couple" and act as one cone with twice the area (therefore twice the efficiency) and twice the power capacity. The additional cone area provides 3 dB more output and the

additional power capacity accounts for the remaining 3 dB.

Specifically, mutual coupling occurs at frequencies whose wavelengths are longer than one-quarter the center-to-center distance between the cones. The highest frequency at which mutual coupling occurs is calculated from the following equation:

$$f @ \frac{3{,}000}{D_{MAX}},$$

where D_{MAX} (inches) is the distance between the cones, and f (Hz) is the highest frequency at which coupling occurs. When D_{MAX} is greater than one-quarter wavelength, which would occur if two TL550D's were widely spaced, or at frequencies much above f even when closely spaced, the increase in acoustic output is limited to the 3-dB power-handling increase.

At frequencies above the mutual coupling limit, f, stacking alters dispersion and increases on-axis sensitivity. In the 500-to-800-Hz range, a common crossover frequency for two-way sound reinforcement systems, two nearly adjacent cones have a coverage angle about half that of either cone alone. This is useful, for example, in more closely matching the typical 40° vertical dispersion of a high-frequency horn. (At frequencies much above 800 Hz, the concept of a halved coverage angle no longer applies, since the side lobes, which result from two sources that are not mutually coupled, increase in number and approach or equal the main lobe in amplitude. The number of lobes and their amplitude increases as frequency increases.)

HIGH-FREQUENCY HORN MOUNTING

The optional HMK-1 and HMK-2 horn mounting kits are available for use, respectively, with the Electro-Voice HP940 small-format and HP9040 large-format constant-directivity horns. The kits are designed to facilitate fixing and aiming the high-frequency horn and driver on top of a vertically oriented TL550D, in cinema stage (behind-the-screen) applications. This configuration may be useful in a number of other applications as well. Refer to the individual HMK-1 and HMK-2 engineering data sheets for details and instructions.

Installation and Suspension of TL550D Enclosure

The TL550D is designed for typical cinema stage (behind-the-screen) applications where low-frequency systems are mounted on platforms, behind the screen and some distance above the stage floor. **The TL550D is not designed to be self-suspended, and if suspended, must be supported and hung in a way which does not depend on the structure of the TL550D itself for support.**

The HS6 and HS7 kits allow the TL550D to be hung safely in a variety of orientations. The combination of the correct HS kits and TL550D enclosure has been certified by an independent structural engineer to be safe and secure. Each HS kit consists of a steel tube, two brackets, two eyebolts and the necessary fasteners. The installer must assemble the HS kit by first drilling two holes into the TL550D enclosure, in predefined positions, and then screwing the brackets onto the steel tube, which passes through the enclosure. An eyebolt is inserted in the T-nut in the rear panel of the enclosure to provide a "pull up" to aim the enclosure. Full instructions and hole locations are included with each cabinet and HS kit. A TL550D requires a single HS6 to suspend it horizontally, or a single HS7 to suspend it vertically. Electro-Voice recommends that only one TL550D be suspended at one time in this manner. Vertical is defined as having the long side vertical. *Full attention must be given to the instructions and limitations in the HS kit instruction sheet.*

Architects' and Engineers' Specifications

The loudspeaker system shall be a dual low-frequency, bass-reflex design. Two 15-inch woofers shall be front mounted in an 8.4-ft^3 enclosure. The system shall meet the following criteria: power handling, 1,200 watts of pink noise with a 6-dB crest factor; frequency response, smooth and uniform, usable at high output levels from 40 to 2,000 Hz; sensitivity, 100 dB at one watt, one meter, 100-800 Hz, on axis; impedance 4 ohms nominal, 4.2 ohms minimum; dispersion angles 120° (horizontal) x 55° (vertical) at 500 Hz. The enclosure shall be constructed of black vinyl-clad particle board. The enclosure will contain sound-absorbing glass wool. Each woofer shall have the capacity to be fed independently of the other. The input panel and connectors shall be side-mounted. The enclosure top panel shall be fitted with T-nuts that accept the optional Electro-Voice HMK-1 and HMK-2 horn mounting kits. A port cover shall be included to enable "step-down" operation for enhanced low-frequency performance. The enclosure dimensions shall be 39.5 in. high x 22.5 in. wide x 21.8 in. deep (100.3 cm x 57.2 cm x 55.4 cm). Net weight shall be 144 lb (65.5 kg). The low-frequency speaker system shall be the Electro-Voice TL550D.

Limited Warranty

Electro-Voice products are guaranteed against malfunction due to defects in materials or workmanship for a specified period, as noted in the individual product-line statement(s) below, or in the individual product data sheet or owner's manual, beginning with the date of original purchase. If such malfunction occurs during the specified period, the product will be repaired or replaced (at our option) without charge. The product will be returned to the customer prepaid. **Exclusions and Limitations:** The Limited Warranty does not apply to: (a) exterior finish or appearance; (b) certain specific items described in the individual product-line statement(s) below, or in the individual product data sheet or owner's manual; (c) malfunction resulting from use or operation of the product other than as specified in the product data sheet or owner's manual; (d) malfunction resulting from misuse or abuse of the product; or (e) malfunction occurring at any time after repairs have been made to the product by anyone other than Electro-Voice Service or any of its authorized service representatives. **Obtaining Warranty Service:** To obtain warranty service, a customer must deliver the product, prepaid, to Electro-Voice Service or any of its authorized service representatives together with proof of purchase of the product in the form of a bill of sale or receipted invoice. A list of authorized service representatives is avail-

able from Electro-Voice Service at 600 Cecil Street, Buchanan, MI 49107 (800/234-6831 or FAX 616/695-4743). **Incidental and Consequential Damages Excluded:** Product repair or replacement and return to the customer are the only remedies provided to the customer. Electro-Voice shall not be liable for any incidental or consequential damages including, without limitation, injury to persons or property or loss of use. Some states do not allow the exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you. **Other Rights:** This warranty gives you specific legal rights, and you may also have other rights which vary from state to state. **Electro-Voice Speakers and Speaker Systems** are guaranteed against malfunction due to defects in materials or workmanship for a period of five (5) years from the date of original purchase. The Limited Warranty does not apply to burned voice coils or malfunctions such as cone and/or coil damage resulting from improperly designed enclosures. Electro-Voice active electronics associated with the speaker systems are guaranteed for three (3) years from the date of original purchase. Additional details are included in the Uniform Limited Warranty statement.

For warranty repair or service information, contact the service repair department at: 616/695-6831 or 800/685-2606.

For technical assistance, contact Technical Support at 800/234-6831 or 616/695-6831, M-F, 8:00 a.m. to 5:00 p.m. Eastern Standard Time.

Specifications subject to change without notice.

FIGURE 1—Axial Frequency Response (anechoic environment, 1 watt/1 meter)

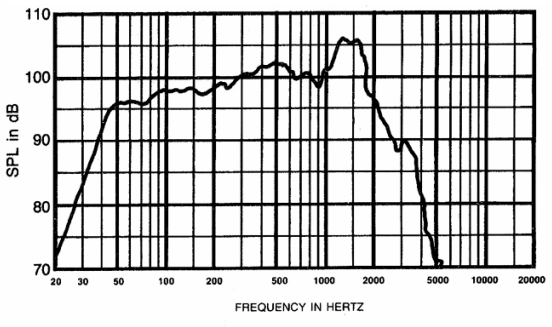


FIGURE 2—TL550D One-Third-Octave Polar Responses (anechoic environment)

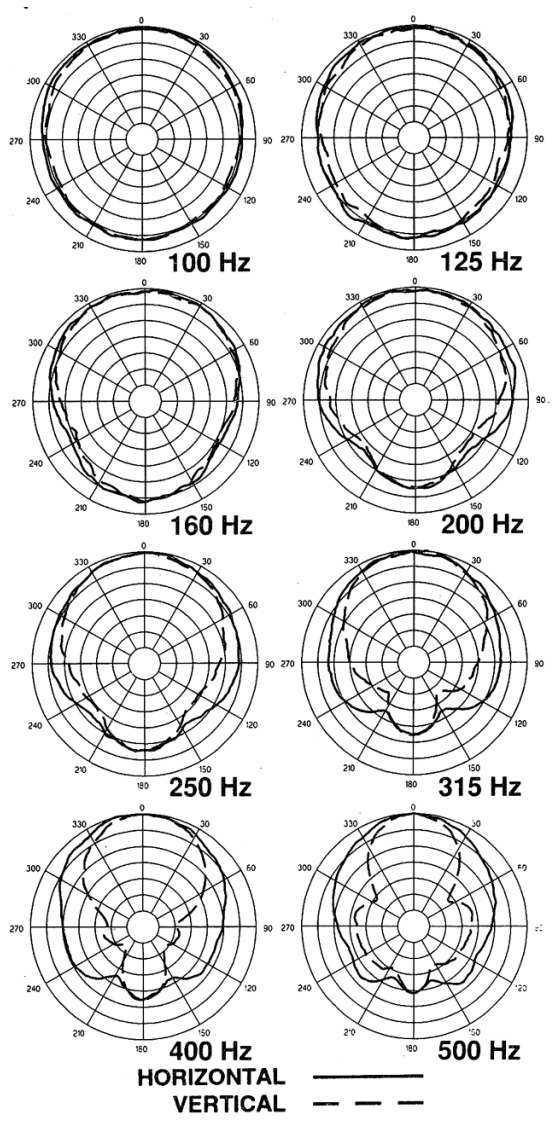


FIGURE 3—TL550D One-Third-Octave Beamwidth vs Frequency (anechoic environment)

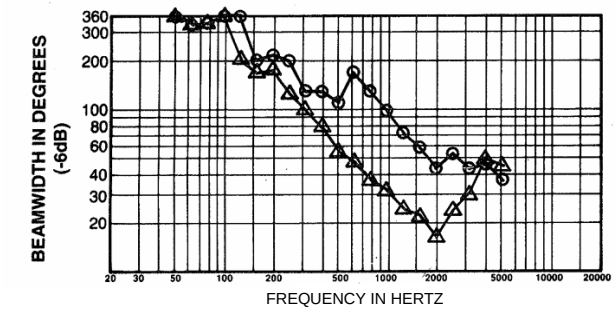


FIGURE 4—TL550D One-Third-Octave Directivity vs Frequency (anechoic environment)

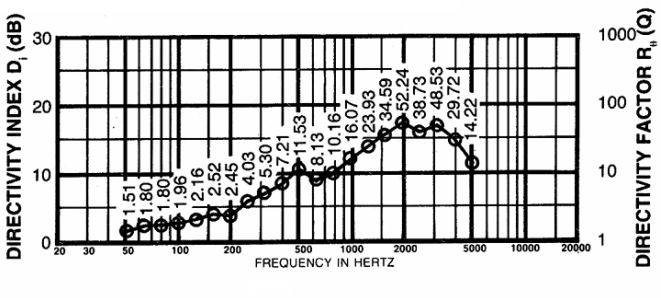


FIGURE 5—TL550D Harmonic Distortion, 0.1 Rated Power Input (120 watts), 10 Feet on Axis

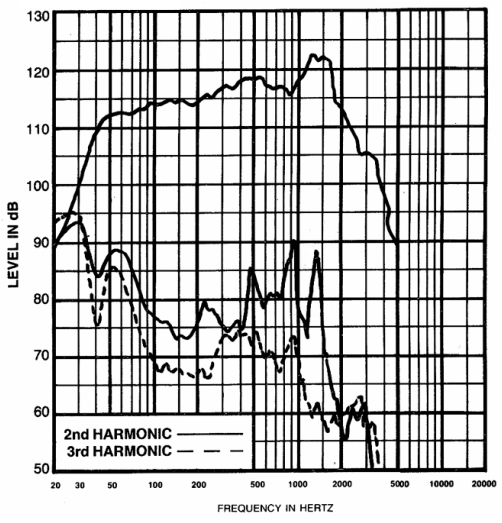
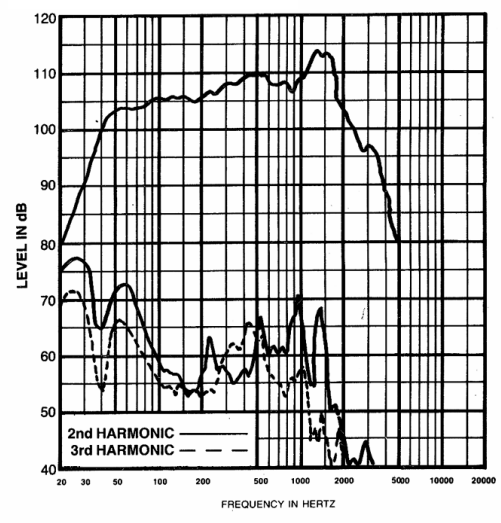


FIGURE 6—TL550D Harmonic Distortion, 0.01 Rated Power Input (12 watts), 10 Feet on Axis



TL550D Low-Frequency Speaker System

SPECIFICATIONS:

Frequency Response, 1 Watt at 1 Meter on Axis, Swept One-Third-Octave Pink Noise, Anechoic Environment (see Figure 1):

40-2,000 Hz

Low-Frequency 3-dB-Down Point,

Normal:

40 Hz

Step-Down (with equalization):

28 Hz

Usable Low-Frequency Limit (10-dB-down point),

Normal:

30 Hz

Step-Down (with equalization):

22 Hz

Half-Space Reference Efficiency:

7.4%

Power-Handling Capacity (see Power Handling section),

Long-Term Average per EIA RS-426A:

1,200 watts

Continuous Program:

2,000 watts

Maximum Long-Term Average Mid-Band Acoustic Output:

89 watts

Sound Pressure Level at 1 Meter, 1 Watt (2.0 volts) Input, Anechoic Environment, Band-Limited Pink-Noise Signal,

100-800 Hz:

100 dB

50-125 Hz:

95 dB

Dispersion Angle Included by 6-dB-Down Points on Polar Responses, Indicated One-Third-Octave Bands of Pink Noise (see Figure 3),

90-125 Hz Horizontal and Vertical:

360°

400-800 Hz Horizontal:

120° ± 10°

400-800 Hz Vertical:

60° ± 20°

Directivity Factor R_q (Q), Median over Indicated Range (see Figure 4),

90-125 Hz:

1.0

400-800 Hz:

9.3

Directivity Index D_i (10 log R_q),

90-125 Hz:

0.0 dB

400-800 Hz:

9.6 dB

Distortion, 0.1 Full Power Input

(see Figure 5),

Second Harmonic,

100 Hz:

1.3%

1,000 Hz:

2.5%

Third Harmonic,

100 Hz:

0.5%

1,000 Hz:

0.6%

Distortion, 0.01 Full Power Input

(see Figure 6),

Second Harmonic,

100 Hz:

0.4%

1,000 Hz:

0.5%

Third Harmonic,

100 Hz:

0.3%

1,000 Hz:

0.2%

Transducer Complement:

Two EVX-150A

Net Box Volume:

238 l (8.4 ft^3)

Box Tuning Frequency,

Normal:

42 Hz

Step-Down:

30 Hz

Step-Down Peak-Boost Frequency (see Step-Down section):

32 Hz

Impedance, Nominal/Minimum (see Electrical Connections section):

4.0/4.2 ohms

Input Connectors:

Side-mounted screw terminals (#10) on barrier strip

Enclosure Materials and Finish:

Black vinyl-clad particle board

Suspension (see Installation and Suspension of TL550D Enclosures section):

Two “independently certified” suspension kits are available, the HS6 and HS7

Optional Horn Mounting Kits:

HMK-1 and HMK-2 (can be used with the HP940 and HP9040 horns, respectively)

Dimensions,

Height:

39.5 in. (100.3 cm)

Width:

22.5 in. (57.2 cm)

Depth:

21.8 in. (55.4 cm)

Net Weight:

59.1 kg (130 lb)

Shipping Weight:

65.5 kg (144 lb)

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